Report from the Airplane Performance Harmonization Working Group

Issue: Accounting for the effect of wet runways on takeoff performance

Rule Section: FAR 121.189, 135.379/JAR-OPS 1.485, 1.490

1 - What is underlying safety issue to be addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

It is fundamental to operational safety that the pilot should be able to either safely complete a takeoff or bring the airplane to a complete stop within the remaining distance available for stopping the airplane, even if power is lost from the most critical engine just before the airplane reaches a defined go/no-go point. This principle has formed the basis of the takeoff performance standards required for the type certification and operation of turbine engine powered transport category airplanes since Special Civil Air Regulation No. SR-422, effective August 27, 1957. As of March 20, 1997, the application of this principle was extended by the "commuter rule" to also cover scheduled passenger-carrying operations conducted in airplanes that have a passenger seat configuration of 10 to 30 passengers and turbojet airplanes regardless of seating configuration.

The defined go/no-go point during the takeoff is provided to the pilot as a speed called V_1. Up to the V_1 speed, the pilot should be able to reject a takeoff and stop within the remaining stopping distance. On a wet runway, the reduced friction degrades an airplane's stopping capability, increasing the distance needed to stop the airplane. If this reduction in stopping capability is not taken into account when determining the maximum takeoff weight and associated V_1 speed, the airplane may not be able to stop within the available stopping distance if the takeoff is rejected from near the V_1 speed.

On a smooth runway surface, the distance needed to stop an airplane when the runway is wet may be characterized as approximately twice the distance that is needed when the runway is dry. (This characterization is intended only as a rough approximation to provide a sense of the magnitude of the effect. The increase in stopping distance can vary considerably, depending on the texture of the runway surface, the effectiveness of the airplane's anti-skid braking system, the amount of water on the runway, the speed of the airplane, the tire tread depth, etc.)

2 - What are the current FAR and JAR standards relative to this subject? [Reproduce the FAR and JAR rules text as indicated below.]

Current FAR text:

Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

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(e) In determining maximum weights, minimum distances, and flight paths under paragraphs (a) through (d) of this section, correction must be made for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

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(g) For the purposes of this section the terms, “takeoff distance,” “takeoff run,” “net takeoff flight path,” and “takeoff path” have the same meanings as set forth in the rules under which the airplane was certificated.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered large transport category airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

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(e) In determining maximum weights, minimum distances, and flight paths under paragraphs (a) through (d) of this section, correction must be made for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

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(g) For the purposes of this section the terms, “takeoff distance,” “takeoff run,” “net takeoff flight path,” and “takeoff path” have the same meanings as set forth in the rules under which the airplane was certificated.

Current JAR text:

JAR-OPS 1.480 Terminology

(b) The terms ‘accelerate-stop distance’, ‘take-off distance’, ‘take-off run’, ‘net take-off flight path’, ‘one engine inoperative en-route net flight path’ and ‘two engines inoperative en-route net flight path’ as relating to the aeroplane have their meanings defined in the airworthiness requirements under which the aeroplane was certified, or as specified by the Authority if it finds that definition inadequate for showing compliance with the performance operating limitations

JAR-OPS 1.485 General

(b) An operator shall ensure that, for the wet and contaminated runway case, performance data determined in accordance with JAR 25X1591 or equivalent acceptable to the Authority is used. (See IEM OPS 1.485(b).)

JAR-OPS 1.490 Take-off

(b) An operator must meet the following requirements when determining the maximum permitted take-off mass:

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(5) On a wet or contaminated runway, the takeoff mass must not exceed that permitted for a take-off on a dry runway under the same conditions.

(c) When showing compliance with sub-paragraph (b) above, an operator must take account of the following:

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(3) The runway surface condition and the type of runway surface (see IEM OPS 1.490(c)(3));

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed? [Reproduce text from issue papers, special conditions, policy, certification action items, etc., that have been used relative to this issue] N/A

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in? [Explain the differences in the standards or policy, and what these differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

The FAA standards currently require that wet runways be taken into account for takeoff only for those airplanes that have operating limitations for wet runway takeoff distances. Since only airplanes that have Amendment 25-92 or equivalent in their type certification basis are required to have such operating limitations and Amendment 25-92 became effective on March 20, 1998, only the most recently certificated airplane types are covered by the FAA standard. For older airplanes, the FAA standards do not require operators to take into account the effect of wet runways when determining maximum takeoff weights and V_1 speeds.

At the time that Amendment 25-92 was adopted, the FAA considered making the standards retroactive to all airplanes operating under Parts 121 and 135. Many comments were received on the FAA's rulemaking proposals at that time, both for and against retroactive application of the wet runway standards. Due to the controversial nature of this issue, the FAA elected to issue the amendment without retroactive application of the standards and add the issue of wet runway takeoff performance for older airplanes to the FAA/JAA harmonization work program. The Performance Harmonization Working Group was tasked with recommending whether the standards adopted by the FAA in the "Improved Standards for Determining Rejected Takeoff and Landing Performance" (*64 Federal Register 202*) should be applied retroactively to all airplanes being operated under Parts 121 and 135.

In contrast to the FAA requirements, JAR-OPS 1 requires operators to account for the effects of wet runways on takeoff performance for all Performance Class A airplanes used in commercial air transportation. (Performance Class A airplanes include multi-engine turbopropeller airplanes with a maximum approved passenger seating configuration of more than 9 seats or a maximum takeoff mass exceeding 5700 kilograms, and all multi-engine turbojet powered airplanes.) In addition, JAR-OPS 1 requires operators to ensure that the wet runway data being used has been developed in accordance with certain criteria provided in JAA advisory material or their equivalent.

On a smooth runway surface, the distance needed to stop an airplane when the runway is wet may be characterized as approximately twice the distance that is needed when the runway is dry. (This characterization is intended only as a rough approximation to provide a sense of the magnitude of the effect. The increase in stopping distance can vary considerably, depending on the texture of the runway surface, the effectiveness of the airplane's anti-skid braking system, the amount of water on the runway, the speed of the airplane, the tire tread depth, etc.) Grooving the runway or applying a porous friction coarse (PFC) surface treatment significantly improves the wet runway stopping capability. However, the effectiveness of the surface treatment in improving wet runway braking friction depends on the manner in which the runway is designed, constructed, and maintained. The FAA has published standards for the measurement, construction, and maintenance of skid-resistance pavement surfaces in Advisory Circular 150/5320-12C.

The standards adopted by the FAA in the "Improved Standards for Determining Rejected Takeoff and Landing Performance" allow operators to take credit for the improved stopping capability on wet runways that are grooved or treated with a PFC overlay, but only if such data are provided in the Airplane Flight Manual and the operator has determined that the runway is designed, constructed, and maintained in a manner acceptable to the Administrator.

Rejected takeoff statistics presented in the Takeoff Safety Training Aid, developed jointly by the aviation industry and the FAA in 1992, show that approximately one-quarter of the rejected takeoff accidents for which runway conditions were reported occurred on wet runways. (Runway conditions were not reported for 28 percent of the rejected takeoff accidents.) (These data, which covered rejected takeoff safety statistics from 1960 to 1990 for all western-built jet transport airplanes, were recently updated by Boeing to extend the database through 1999.) Since it is estimated that less than 10 percent of takeoffs are made from wet runways (see the discussion of the Final Regulatory Evaluation for Amendment 25-92 in item 16 below for the source of this estimate), the risk of a rejected takeoff accident is disproportionately greater on a wet runway than on a dry runway.

According to the updated database maintained by Boeing, there have been an estimated 365,950,917 departures of western-built jet transports in the period from 1960-1999. Assuming that 6 percent of these departures occurred on wet runways (in accordance with the FAA's Final Regulatory Evaluation for Amendment 25-92 to part 25 as discussed

under Item 16 of this report), there were an estimated 343,993,862 dry runway takeoffs and 21,957,055 wet runway takeoffs. Of the 94 rejected takeoff overruns, 37 occurred on runways reported as dry and 22 occurred on runways reported as wet. Thus, the in-service data shows accident rates of .10756 per million takeoffs on dry runways and 1.00196 per million takeoffs on wet runways, which means the accident rate on wet runways has been more than 9 times the rate on dry runways.

Retroactively applying the "Improved Standards for Determining Rejected Takeoff and Landing Performance" would increase the safety of takeoffs from wet runways by increasing the runway length required for takeoff. For flights that are operating at the maximum allowable weight for the given runway (i.e., the flight is field-length-limited) under dry conditions, this requirement could lead to a loss in revenue in wet conditions. Because the runway length is fixed (unless a longer runway is available for use at that airport), the airplane's takeoff weight would have to be reduced to offset the decrease in stopping capability. If the number of passengers or amount of cargo to be carried must be reduced to reduce the airplane's takeoff weight, an airplane operator would suffer a loss of revenue.

The "Improved Standards for Determining Rejected Takeoff and Landing Performance" contain a number of provisions to lessen the economic impact associated with the wet runway requirements. First, the required height over the end of the takeoff distance was reduced from the 35 feet required for dry runways to 15 feet for wet runways. Second, the effect of using reverse thrust to assist in stopping the airplane can be taken into account on wet runways, but not on dry runways. Third, credit may be taken for the increased braking friction available on grooved and PFC runways.

The JAR standards provide a higher level of safety than the FAR when operating from wet runways. In achieving this higher level of safety, the JAR standards impose an economic burden on JAR operators that is not borne by FAR operators.

4 - What, if any, are the differences in the current means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

The differences in the means of compliance are due to the differences in the standards. Where the standards are the same (i.e., wet runway accountability for new airplane types), the means of compliance are the same.

5 – What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

The Performance Harmonization Working Group recommends that wet runway requirements be added to Parts 121 and 135, and harmonization achieved with JAR-OPS 1, subject to the following conditions:

1. Maximum use is made of currently available data (i.e., minimize any need for development of new data).
2. One-engine-inoperative takeoff distance is based on a 15-foot screen height.
3. Performance credit may be taken for available reverse thrust.
4. Performance credit may be taken for the better stopping capability of grooved and PFC runways without requiring airplane operators to make the determination that the runway surface treatment has been adequately designed, constructed, and maintained.
5. Except for airplanes certificated under the current Part 25 wet runway requirements, the wet runway performance information used to show compliance with these proposed requirements would be considered supplementary data under the proposed § 121.173(a)/135.363(a).
6. Exemptions would be available for out-of-production airplanes for which there is no wet runway takeoff performance information available.

This action would harmonize the JAR and the FAR and would require all operations under JAR-OPS 1 and FAR Parts 121 and 135 to comply with the wet runway requirements, regardless of the type certification basis of the airplane. Although this would be similar to applying the wet runway requirements of the "Improved Standards for Determining Rejected Takeoff and Landing Performance" retroactively, there would be several differences that would apply to airplanes not certificated under the current Part 25 wet runway standards. The working group recommends use of the following criteria to determine data acceptability:

1. The braking coefficient used to determine the wet runway stopping distance need not be based on the methodology used in the current Part 25 standards. For the wet runway braking coefficient, data based on the current Part 25 methodology, the JAR AMJ 25X1591 methodology, one-half the dry runway braking coefficient, or equivalent would be acceptable.
2. The wet runway performance information need not be furnished in the Airplane Flight Manual. This information would be considered supplementary data under the proposed revision to § 121.171(a)/135.363(a).
3. One-engine-inoperative takeoff distances may be based on a 15-foot screen height.
4. Consistent with the current Part 25 wet runway requirements, performance credit for clearways in combination with a 15-foot screen height would not be allowed.
5. Performance credit may be taken for the use of available reverse thrust in the same manner as the current Part 25 wet runway standards.

For each proposed change from the existing standard, answer the following questions:

6 - What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that at which compliance with the following may be shown for the runway to be used:

(1) The accelerate-stop distance must not exceed the accelerate-stop distance available.

(2) The takeoff distance must not exceed the takeoff distance available with any clearway distance not exceeding half of the takeoff run available.

(3) The takeoff run must not be greater than the takeoff run available.

[Note: The working group did not reach consensus on the following paragraph (see Working Group Reports 4 and 5)]:

For contaminated runway accountability on a one-engine-inoperative performance basis:

(4) The same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section.

For contaminated runway accountability on all engines-operating performance basis:

(4) For runways that are dry or wet, the same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section. For contaminated runways, V_{Stop} must be used to show compliance with paragraph (c)(1) of this section.

(5) On a wet or contaminated runway, the takeoff weight must not exceed that permitted for takeoff on a dry runway under the same conditions.

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(e) In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–

(1) The pressure altitude at the airport;

(2) The ambient temperature at the airport;

(3) The runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved);

(4) The runway slope in the direction of takeoff; and

(5) Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component; and

(6) The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff.

(f) Wet runway accelerate-stop distances associated with grooved or porous friction course runways may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay.

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(j) For the purposes of this section the terms, “accelerate-stop distance,” “takeoff distance,” “takeoff run,” “net takeoff flight path,” “takeoff path,” “one-engine-inoperative en route net flight path,” and “two-engines-inoperative en route net flight path” have the same meanings as set forth in the rules under which the airplane was certificated, or as specified by the Administrator if that definition is found unsuitable for showing compliance with the performance operating limitations.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered large transport category airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that at which compliance with the following may be shown for the runway to be used:

(1) The accelerate-stop distance must not exceed the accelerate-stop distance available.

(2) The takeoff distance must not exceed the takeoff distance available with any clearway distance not exceeding half of the takeoff run available.

(3) The takeoff run must not be greater than the takeoff run available.

[Note: The working group did not reach consensus on the following paragraph (see Working Group Reports 4 and 5)]:

For contaminated runway accountability on a one-engine-inoperative performance basis:

(4) The same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section.

For contaminated runway accountability on all engines-operating performance basis:

(4) For runways that are dry or wet, the same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section. For contaminated runways, V_{Stop} must be used to show compliance with paragraph (c)(1) of this section.

(5) On a wet or contaminated runway, the takeoff weight must not exceed that permitted for takeoff on a dry runway under the same conditions.

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(e) In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–

(1) The pressure altitude at the airport;

(2) The ambient temperature at the airport;

(3) The runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved);

(4) The runway slope in the direction of takeoff; and

(5) Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component; and

(6) The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff.

(f) Wet runway accelerate-stop distances associated with grooved or porous friction course runways may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay.

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(j) For the purposes of this section the terms, “accelerate-stop distance,” “takeoff distance,” “takeoff run,” “net takeoff flight path,” “takeoff path” have the same meanings as set forth in the rules under which the airplane was certificated, or as specified by the Administrator if that definition is found unsuitable for showing compliance with the performance operating limitations.

JAR-OPS 1

JAR-OPS 1.480 Terminology

(b) The terms ‘accelerate-stop distance’, ‘take-off distance’, ‘take-off run’, ‘net take-off flight path’, ‘one engine inoperative en-route net flight path’ and ‘two engines inoperative en-route net flight path’ as relating to the aeroplane have their meanings defined in the airworthiness requirements under which the aeroplane was certified, or as specified by the Authority if it finds that definition unsuitable for showing compliance with the performance operating limitations

JAR–OPS 1.485 General

(b) For the wet and contaminated runway case, performance data determined in accordance with JAR 25X1591, or other data ensuring a similar level of safety acceptable to the Authority must be used. (See IEM OPS 1.485(b)).

JAR-OPS 1.490 Take-off

(b) An operator must meet the following requirements for the runway to be used when determining the maximum permitted take-off mass:

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(5) On a wet or contaminated runway, the take-off mass must not exceed that permitted for a take-off on a dry runway under the same conditions.

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(c) When showing compliance with subparagraph (b) above, an operator must take account of the following:

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(3) The runway surface condition and the type of runway surface (See IEM OPS 1.490(c)(3)).

IEM No. 2 OPS 1.490(c)(3) – Type of Runway Surface (Grooved and Porous Friction Course).

Where an identified paved runway has been prepared and maintained with a grooved or porous friction course (PFC) in accordance with a standard such as FAA AC 150/5320-12A, or other equivalent acceptable to the Authority, performance credit may be taken, provided that approved performance data is in the AFM and is identified as appropriate for use in conjunction with a grooved or PFC runway.

Summary of Proposed Changes:

[Note: The proposed changes discussed below include more than just the changes associated directly with the issue of retroactive application of wet runway takeoff performance requirements. This was done for completeness and clarity due to the many changes being proposed for the rule sections that address takeoff limitations. Therefore, some of the proposed changes described below will either be repeated or more fully explained in other working group reports.]

(1) Amend §§ 121.189(c) and 135.379(c) to remove the words "listed in the Airplane Flight Manual." Currently, §§ 121.189(c) and 135.379(c) require that the Airplane Flight Manual (AFM) must be used to determine the maximum takeoff weight for which compliance is shown with the field length requirements of those sections. As noted in Working Group Report 1, for most of the new performance requirements being proposed by the Performance Harmonization Working Group (e.g., runway alignment distance, retroactive application of wet runway requirements, contaminated runway requirements), airplane performance data not currently furnished in AFM's will be needed in order to show compliance. While the working group recommends that the subject of AFM data requirements be further investigated by a working group tasked with such part 25 issues, the working group recommends proceeding with this rulemaking without waiting for that task to be completed. Until that task is completed, operators should be able to show compliance to the proposed wet runway takeoff limitations using supplementary data acceptable to the regulatory authority.

Removing the words "listed in the Airplane Flight Manual" from §§ 121.189(c) and 135.379(c) would leave the proposed §§ 121.173(a) and 135.363(a) (i.e., as proposed in Working Group Report 1), respectively, as the applicable requirements regarding the source of data for showing compliance with §§ 121.189(c) and 135.379(c). The proposed §§ 121.173(a) and 135.363(a) state that the performance data in the Airplane Flight Manual, supplemented as necessary with other data acceptable to the Administrator, applies in determining compliance with §§ 121.175 through 121.197 and §§ 135.365 through 135.387, respectively.

(2) Amend §§ 121.189(c) and 135.379(c) to add the words "for the runway to be used" to clarify that compliance with this requirement must be shown for the runway to be used. This is a clarifying change only.

(3) Amend §§ 121.189(c)(1), (c)(2), and (c)(3) and §§ 135.379(c)(1), (c)(2), and (c)(3) to use the terms "accelerate-stop distance available," "takeoff distance available," and "takeoff run available," which would be defined in the proposed new §§ 121.173(i) and 135.363(i). (See Working Group Report 1 for proposed accompanying amendments to §§ 121.173 and 135.363). This change would harmonize the wording of the JAR and FAR standards, but would not change the requirement.

(4) Add, as a new § 121.189(c)(4) and new § 135.379(c)(4), a requirement that the same value of V_1 must be used to show compliance with the accelerate-stop, takeoff run, and takeoff distance limitations. This requirement would ensure that, from a single defined go/no-go point (i.e., the V_1 speed), the takeoff can either be safely completed, or the airplane can be brought to a stop within the remaining distance available for stopping the airplane. Although the current FAR requires this capability through the interaction of the part 25 definitions for takeoff and accelerate-stop distances and the associated operating requirements, adding the proposed paragraph would make this requirement more explicit. With the addition of the proposed takeoff limitations for operations from wet runways, the proposed §§ 121.189(c)(4) and 135.379(c)(4) would clarify that these limitations must include accountability for failure of the critical engine. (See the additional discussion on this issue in Working Group Reports 4 and 5. Note that the working group did not reach consensus on whether this requirement should apply to takeoffs from contaminated runways. This lack of consensus is addressed in Working Group Reports 4 and 5.) This change would also harmonize the FAR with the current JAR standard.

(5) New §§ 121.189(c)(5) and 135.379(c)(5) would be added to require that the takeoff weight on a wet or contaminated runway not exceed the takeoff weight permitted on a dry runway under the same conditions. It would be inappropriate, from a safety standpoint, to allow a higher maximum takeoff weight from a wet runway than from a dry runway under otherwise identical conditions. Without the proposed requirement, this situation could potentially occur due to differences in the methods for determining the distances used in establishing the maximum allowable takeoff weight. (In determining the wet runway distances, unlike for dry runway distances, credit can be taken for reverse thrust for stopping the airplane during a rejected takeoff. Also, for a continued takeoff, the airplane can be at a height of 15 feet over the end of a wet runway, but must be at a height of 35 feet (if there is no clearway) for a dry runway.) [Note: Because contaminated runways would also be covered by this proposed change, this proposal is repeated in the Working Group Reports 4 and 5, which address proposed new standards for contaminated runways.]

(6) Reformat §§ 121.189(e) and 135.379(e) to list, in separate sub-paragraphs, each of the items for which correction must be made. Currently, §§ 121.189(e) and 135.379(e) require correction made to the maximum weights, minimum distances, and flight paths under paragraphs §§ 121.189(a) through (d) and §§ 135.379(a) through (d), respectively, for the runway to be used, the elevation of the airport, the effective runway gradient, the

ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Sections 121.189(e) and 135.379(e) also state that wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

Under this proposal, §§ 121.189(e) and 135.379(e) would be revised to state, "In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–." "The pressure altitude at the airport" would be listed in new §§ 121.189(e)(1) and 135.379(e)(1). The use of pressure altitude instead of elevation is consistent with changes being proposed throughout this subpart. It reflects the practice that the determination of takeoff weights are normally done on the basis of pressure altitude, and that Airplane Flight Manual performance information is provided as a function of pressure altitude. The words "at the airport" would replace "of the airport," and are intended to allow correction for pressure altitude of the specific runway. The words "of the airport" imply the use of the pressure altitude of the airport itself, which is that of the highest touchdown zone of any runway at the airport.

New §§ 121.189(e)(2) and 135.379(e)(2) would list "the ambient temperature at the airport." New §§ 121.189(e)(3) and 135.379(e)(3) would list "the runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved)." This proposed change would require correction to be made for wet runways regardless of whether operating limitations exist in the AFM for wet runways. (For a discussion of the addition of correcting for contaminated runways, see Working Group Reports 4 and 5.)

The proposed new §§ 121.189(e)(3) and 135.379(e)(3) would also add a requirement to correct for the type of runway surface (paved or unpaved). This new requirement is intended to ensure that the applicable takeoff limitations for approved operations on unpaved runway surfaces, such as grass or gravel runways, are based on performance data appropriate to the type of runway surface. This proposal would codify current FAA practice, which permits operations on unpaved runway surfaces through special operational approvals under the authority of § 121.173(f). It would also harmonize this issue with JAR-OPS 1. In accordance with FAA policies developed for these special operational approvals, the limitations, procedures, and performance information for unpaved runway operation must be presented in the Airplane Flight Manual (usually in an appendix or supplement). Airworthiness certification guidance to support approval for unpaved runway operations is provided in FAA Advisory Circular 25-7A, "Flight Test Guide for Certification of Transport Category Airplanes."

New §§ 121.189(e)(4) and 135.379(e)(4) would list "The runway slope in the direction of takeoff." This item is currently listed in §§ 121.189(e) and 135.379(e) as "the effective

runway gradient." The wording change would harmonize the wording with that of the JAR standard and is not intended to change the existing requirement regarding the effect of runway slope.

New §§ 121.189(e)(5) and 135.379(e)(5) would list "Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component." This would replace the criterion, "wind component at the time of takeoff," currently listed in §§ 121.189(e) and 135.379(e). The proposed wording is intended to clarify that the total wind (i.e., wind speed and direction), not just the headwind or tailwind component, must be considered. For corrections to takeoff distances, only the headwind or tailwind component is relevant. However, for flight path considerations, the total wind must be taken into account. (Note: This issue is addressed in Working Group Report 6.)

The proposed wording also includes the factors applied to the headwind and tailwind components ("not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component") that are currently required by the airworthiness type certification requirements of part 25. The working group proposes that these wind factors should be applied to all operations conducted under §§ 121.189 and 135.379, regardless of the certification basis of the airplane.

New §§ 121.189(e)(6) and 135.379(e)(6) would list the new requirement proposed in Working Group Report 3, "The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff." (See that working group report for the reasons for this change.)

These proposed changes to §§ 121.189(e) and 135.379(e) would harmonize the requirements contained in those sections with JAR-OPS 1.490, when amended as proposed later in this report.

(7) Replace the existing §§ 121.189(e)/135.379(e) requirements related to grooved and PFC runways with new §§ 121.189(f)/135.379(f) (and renumbering the remaining paragraphs of §§ 121.189 and 135.379 accordingly) to state, "Wet runway distances associated with grooved or porous friction course runways may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay." This proposed revision would remove the requirement for operators to determine that these surface treatments are designed, constructed, and maintained in a manner acceptable to the Administrator. The working group recommends that this concern be addressed through appropriate changes in applicability and enforcement of existing airport design standards. (Note that § 91.605(b)(3), which is equivalent to the existing §§ 121.189(e) and 135.379(e), should also be revised to eliminate the requirement for operators to determine that the grooved or PFC runway surfaces are designed, constructed, and maintained in a manner acceptable to the Administrator.)

(8) Redesignate existing §§ 121.189(g) and 135.379(g) as §§ 121.189(j) and 135.379(j), respectively, revise these paragraphs to add the term "accelerate-stop distance," to the list of terms that, for the purposes of this section, have the same meaning as set forth in the rules under which the airplane was certificated, and add a provision to enable use of definitions for those terms other than as set forth in the rules under which the airplane was certificated. The addition of the term "accelerate-stop distance" would be made for completeness and to harmonize with the JAR standard. Adding the capability to use definitions for those terms other than as set forth in the rules under which the airplane was certificated is necessary to allow, for example, the use of a 15-foot screen height for wet runways in the definition of the one-engine-inoperative takeoff distance for airplanes that were certificated under rules that defined the one-engine-inoperative takeoff distance with a 35-foot screen height. This change would also harmonize with the JAR standard.

Although the equivalent JAR-OPS 1 standard also contains the terms "one-engine-inoperative en route net flight path" and "two-engines-inoperative en route net flight path" in the list of terms for which the definition is the same as set forth in the certification rules, we do not propose to add these terms to the FAR standard. Sections 121.189(j) and 135.379(j) only apply to the terms used in §§ 121.189 and 135.379, respectively, and those terms are not used in these sections. Also, the terms used in the applicable section of parts 121 and 135 refer to the "one (or two)-engine(s)-inoperative net en route flight path data," which does not need further definition.

The JAA considered adding the term "takeoff flight path" to the list of terms given in JAR 1.480(b), but elected not to do so. This term is listed in the existing §§ 121.189(g) and 135.379(g) (and will be carried over to the proposed §§ 121.189(j) and 135.379(j)) because of the need to address airplanes certificated under Special Civil Air Regulation No. SR-422. The term "net takeoff flight path" had not been introduced at the time of SR-422, and the takeoff obstacle clearance limitations in the operating rules referenced the "takeoff flight path." Since there are still airplanes certificated under SR-422 that are operating under parts 121 and 135, and the operating limitations appropriate to those airplanes have been retained (e.g., § 121.189(d)(1)), there is a need to retain this term in the proposed §§ 121.189(j) and 135.379(j). Since JAR-OPS 1 does not have provisions for application to SR-422 certificated airplanes, there is no need to add this term to JAR-OPS 1.480(b).

(9) Amend JAR-OPS 1.480 to replace the word "inadequate" with "unsuitable." This provision allows the use of definitions for the terms listed in the paragraph other than those used in the rules under which the airplane was certificated. The intent of this provision is to allow, for example, the use of a 15-foot screen height for wet runways where the rules under which the airplane was certificated define the takeoff distance with a 35-foot screen height. However, the definition of takeoff distance in the rules under which the airplane was certificated in this situation is better described as unsuitable rather than inadequate.

(10) Amend JAR OPS 1.485(b) to revise the requirement for the operator to ensure that the performance data for wet and contaminated runways was determined in accordance with JAR 25 X 1591, or an acceptable equivalent method. These data are normally developed by the aeroplane manufacturer, and the operator typically does not have the means to independently ensure that a method acceptable to the Authority was used. JAR OPS 1.4859(b) would be revised to state that for the wet and contaminated runway case, performance data determined in accordance with JAR 25X1591, or other data ensuring a similar level of safety acceptable to the Authority must be used.

(11) Amend JAR-OPS 1.490(b) to add the words "for the runway to be used" to clarify that compliance with this requirement must be shown for the runway to be used. This is a clarifying change only.

(12) Amend JAR-OPS 1.490(b)(4) to revise the text to read, "Compliance with this paragraph must be shown using the same value of V_1 for the rejected and continued take-off." This change would replace the current words "…single value of V_1…" with the words "…same value of V_1." This change is a clarification in that there may be a range of V_1 speeds to choose from, but the intent is that the same one must be used for both the rejected and continued takeoff analyses.

7 - How does this proposed standard address the underlying safety issue (identified under #1)? [Explain how the proposed standard ensures that the underlying safety issue is taken care of.]

The proposed standard addresses the underlying safety issues by requiring operators to take into account the effect of wet runways on takeoff performance for all turbine powered airplanes operated under Parts 121 or 135. For the JAA, the proposed standard continues to require operators to take into account the effect of wet runways for all Performance Class A airplanes. Although the text of the FAA and JAA standards would not be identical, the requirements would be harmonized.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

In general, the proposed standard increases the level of safety relative to the current FAR. It would add a requirement that does not currently exist such that operators of airplanes not certificated under the provisions of Amendment 25-92 or equivalent would be required to take into account the effects of wet runways on takeoff performance. For runways with well maintained grooved or porous friction course surfaces, the proposed standard is not expected to increase or decrease the level of safety.

9 - Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Since industry practice may be different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

Industry practice varies, but in general, many operators already take wet runways into account when determining maximum takeoff weights and V_1 speeds. For those operators, the proposed standard would maintain the existing level of safety. For those operators who currently do not account for wet runways, the proposed standard would generally increase the level of safety, as noted in the response to item 8 above.

10 - What other options have been considered and why were they not selected? [Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

The alternatives would be to harmonize on the current FAR standard or retain the current non-harmonized standards. The former option was not selected because it was considered unacceptable to continue to allow the older airplane types to operate at the lower level of safety. The latter option was not selected because it would continue the current situation in which the JAR standard requires a higher level of safety and results in an economic advantage for FAR operators over common route with common equipment.

11 - Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

Operators of transport category airplanes could be affected by the proposed change because they may have to carry out additional analyses for takeoffs from wet runways and may realize a loss in revenue if the payload must be reduced in order to comply with the wet runway requirements. Manufacturers of transport category airplanes could be affected because they generally develop the data to perform the wet runway analysis.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble? [Does any existing advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

None.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory material (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

Advisory material, in the form of an AC, should be adopted to provide guidelines and an acceptable means of compliance with the proposed standard. The advisory material should be consistent with the working group's recommendation to make maximum use of existing data, minimizing any need for developing new data. The means of compliance for airplanes not certificated under Amendment 25-92 (or an equivalent means) should include the following criteria to determine data acceptability:

1. The braking coefficient used to determine the wet runway stopping distance need not be based on the methodology used in the current part 25 standards. For the wet runway braking coefficient on smooth runways, data based on the current part 25 methodology, the JAR AMJ 25X1591 methodology, one-half the dry runway braking coefficient, or equivalent would be acceptable. For grooved or PFC runways, 70 percent of the dry runway braking coefficient may be used, consistent with the current part 25 requirements.
2. The wet runway performance information (including grooved/PFC data, if provided) need not be furnished in the Airplane Flight Manual. This information would be considered supplementary data under the proposed revision to §§ 121.173(a) and 135.363(a). (See Working Group Report 1 for a description of the proposed revision to §§ 121.173(a) and 135.363(a).)
3. One-engine-inoperative wet runway takeoff distances may be based on a 15-foot screen height.
4. Consistent with the current part 25 wet runway requirements, performance credit for clearways would not be allowed in combination with 15-foot screen heights for wet runway takeoffs.
5. Performance credit may be taken for the use of available reverse thrust in the same manner as the current part 25 wet runway standards.

Regulatory implementation of items 3-5 would be through the use of the proposed capability to allow use of definitions of takeoff distance and accelerate-stop distance different than those used by the rules under which the airplane was certificated if that definition is found unsuitable for showing compliance with the performance operating limitations.

14 - How does the proposed standard compare to the current ICAO standard?
[Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

ICAO Annex 6 (Operation of Aircraft), Chapter 5, 5.2.6 states, "In applying the Standards of this chapter, account shall be taken of all factors that significantly affect the performance of the aeroplane (such as: mass, operating procedures, the pressure-altitude appropriate to the elevation of the aerodrome, temperature, wind, runway gradient and condition of runway, i.e. presence of slush, water and/or ice, for landplanes, water surface condition for seaplanes). Such factors shall be taken into account directly as operational parameters or indirectly by means of allowances or margins, which may be provided in the scheduling of performance data or in the comprehensive and detailed code of performance in accordance with which the aeroplane is being operated."

The current FAR does not comply with this ICAO standard in that the FAR does not require the runway condition, in terms of the presence of slush, water and/or ice to be taken into account for the scheduling of takeoff performance data. The proposed standard would bring the FAR closer to compliance with the ICAO standard by requiring the effect of wet runways to be taken into account.

15 - Does the proposed standard affect other HWG's? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why.]

No.

16 - What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

There is not expected to be a cost impact for those operators who currently take wet runways into account when determining maximum takeoff weights and V_1 speeds. Operators who do not take wet runways into account could suffer a loss of payload for each flight in which the takeoff weight must be reduced to comply with the proposed standard. Also, these operators will incur costs for modifying their takeoff analysis procedure to include consideration of wet runways.

For runways where wet runway performance associated with grooved or porous friction course surface treatments can be used, the cost impact is expected to be minimal. An overwhelming majority of primary commercial service airports in the United States, which account for over 99 percent of commercial emplanements, have grooved or PFC runways available. To take advantage of the improved performance available on grooved or PFC runways, however, airplane manufacturers will incur costs associated with generating the performance data. For airplanes certificated prior to Amendment 25-92, such data generally does not exist.

If grooved or PFC performance credit is not available, the annual costs of the proposed standard for 6 major U.S. air carriers who are not currently accounting for the effect of wet runways on takeoff performance are estimated to be about $ 25 million. This cost estimate used an assumption that runways are wet about 20% of the time.

In the Final Regulatory Evaluation for Amendment 25-92 to Part 25, the FAA estimated the costs of complying with the wet runway requirements of that amendment without grooved or PFC runway credit to be approximately $2,700 per airplane per year, or $68,000 per airplane over its service life. This cost estimate was based on 31% of departures being conducted on wet runways. The percentage of departures being conducted on wet runways was determined as follows. "In a sample of 83 major U.S.

cities, it was found that, on average, measurable precipitation fell on 114.5 days per year (31.3 percent). It is estimated that wet runway conditions exist, on average, 20 percent of the time on days having measurable precipitation. Thus, about 6 percent (20 percent of 31 percent) of all takeoffs actually occur on wet runways. However, this analysis conservatively assumes that costs associated with the wet runway requirements will apply on any day having measurable precipitation, while the benefits will only apply to actual wet runway takeoffs. This follows since it is assumed that operators would not risk using dry runway calculations under the threat of precipitation."

17 - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

N/A

18 - Does the HWG wish to answer any supplementary questions specific to this project? [If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.]

No.

19 – Does the HWG want to review the draft NPRM prior to publication in the Federal Register?

Yes.